WHAT IS CLAIMED IS:

1. A control apparatus for controlling a control system having a transfer function regarded as a second order system, comprising:

an outer loop configured to execute a negative-feedback of an output x of the controlled system to obtain a deviation e between the output x and a desired value r;

a first inner loop configured to execute a negative-feedback of a signal k1 (dx/dt), obtained by multiplying a gain k1 to a differentiated value (dx/dt) of the output x of the controlled system, to the deviation e; and

a second inner loop configured to use the differentiated value (dx/dt) of the output x of the controlled system and a product, obtained by multiplying a gain k2 to an absolute value $|e|$ of the deviation e or n powers (n: integer) of the absolute value $|e|$, to execute the positive feedback of a signal of $k2(dx/dt) \cdot |e|$ or $k2(dx/dt) \cdot |e|^n$ to the deviation e,

wherein the controlled system is controlled using a signal which is fed back through the first and the second inner loops.

2. A control apparatus according to claim 1, wherein, when the controlled system includes a position control model, an adjusting element which changes the gain k2 to $c / |r|$ or $c / |r|^n$ based on the desired value

r is provided.

3. A control apparatus according to claim 1, wherein a loop gain is inserted in the outer loop, when the controlled system has a transfer function with a proportional gain.

4. A control apparatus according to claim 1, wherein the gains k1 and k2 are set to values meeting the following equation of damping coefficients of a control system which are zero and positive:

$J+k1-k2\,|r| \geqq 0$ or $J+k1-k2\,|r|^n \geqq 0$, where J is a constant determined due to the controlled system with a secondary delay.

5. A control apparatus according to claim 4, wherein, when the controlled system is a position control model, an adjusting element which changes the gain k2 to $c/|r|$ or $c/|r|^n$ based on the desired value r is provided.

6. A control apparatus according to claim 4, wherein, when the controlled system has a transfer function including a proportional gain, a loop gain is inserted in the outer loop.

7. A control apparatus comprising:

an outer feedback loop which performs negative feedback of an output from a controlled system;

a deviation computing unit which computes a deviation between a desired value and a controlled variable or output of the outer feedback loop;

a first inner feedback loop which performs negative feedback of a product of a differential value of the controlled variable or speed and a gain;

a compensation unit which performs processing for canceling the deviation from the deviation computing unit by a compensation signal from the first inner feedback loop; and

a second inner feedback loop which changes a damping coefficient of a control system according to the deviation from the deviation computing unit.

8. A control apparatus according to claim 7, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain Kf to perform feedback of the product.

9. A control apparatus according to claim 7, wherein the second inner feedback loop comprises a laplace operator which outputs a differential value of a controlled variable or speed of the controlled system, an absolute value computing element which computes an absolute value of the deviation obtained from the deviation computing element or n-th (n=1, 2, 3, ···) power of the absolute value, a gain computing element which multiplies the computation output of the absolute value computing element with another gain, and a positive feedback element which performs positive

feedback of a product of the output of the gain computing element and a differential value of the controlled variable or speed to the compensation element.

10. A control apparatus according to claim 9, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain Kf to perform feedback of the product.

11. A control apparatus according to claim 7, wherein the first inner feedback loop comprises a computing element having a laplace operator which takes out a differential output of the controlled variable or output of the controlled system, and a gain computing element which multiplies the differential output from the computing element by the gain to obtain the product.

12. A control apparatus according to claim 11, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain Kf to perform feedback of the product.

13. A control apparatus according to claim 11, wherein the second inner feedback loop comprises a laplace operator which outputs a differential value of

a controlled variable or speed of the controlled system, an absolute value computing element which computes an absolute value of the deviation obtained from the deviation computing element or n-th (n=1, 2, 3, ···) power of the absolute value, a gain computing element which multiplies the computation output of the absolute value computing element with another gain, and a positive feedback element which performs positive feedback of a product of the output of the gain computing element and a differential value of the controlled variable or speed to the compensation element.

14. A control apparatus according to claim 13, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain Kf to perform feedback of the product.